



ADVANCED SUBSIDIARY GCE
HUMAN BIOLOGY
Case Studies

2858/01

INSERT 1

Thursday 8 January 2009
Morning

Duration: 45 minutes



INSTRUCTIONS TO CANDIDATES

- Questions 1 and 2 are based on the articles that follow on pages 2 to 5 of this insert.

INFORMATION FOR CANDIDATES

- This document consists of **8** pages. Any blank pages are indicated.

Case Study 1

TUBERCULOSIS – THE GREATEST KILLER IN HISTORY?

Tuberculosis (TB) is caused by the bacteria *Mycobacterium tuberculosis*. The most common form of TB is pulmonary TB, but the same bacterium can also cause ulceration of tissues and damage to bones. Evidence obtained from studying skeletons suggests that TB was a killer in ancient Egypt.

TB has often been given other colourful names due to the many symptoms the bacterium causes. Historically, Kings of England and France were believed to have healing powers to cure one form of TB known as scrofula, which was given the name 'The King's Evil'. Scrofula is caused by the bacterium infecting the lymph nodes and was said to be cured by a touch from the hand of the King. The last English monarch to believe in the practice seems to have been Queen Anne, and the writer Samuel Johnson was one of the sufferers to be touched.

Samuel Johnson was one of many famous writers who were victims of TB, and the three Brontë sisters all died of it. Many Kings and political leaders have been victims of TB, including Nelson Mandela. The scientists Anders Celsius and Erwin Schrödinger died of the disease. TB has played a key role in literature and music with characters such as Fantine in *Les Misérables*, Mimi in *La Bohème*, Violetta in *La Traviata* and Satine in *Moulin Rouge* all dying tragically from the disease. These fictional characters also illustrate that, while more men are diagnosed with TB than women, women do seem to have a higher rate of progression from infection to disease in their early reproductive years.

It was Robert Koch who demonstrated that TB is caused by a bacterium, but it was another scientist, Paul Ehrlich, who perfected the staining technique which is still used to visualise the bacterium today. Interestingly, in 1887, Ehrlich became concerned by symptoms he developed, which included a persistent cough. Using the stain he had developed, he was able to show that he was indeed infected by the TB bacterium.

Ehrlich survived and it is possible that this encounter with the disease led him to envisage a possible means of treatment. Ehrlich wrote:

"If we picture an organism as infected by a certain species of bacterium, it will ... be easy to effect a cure if substances have been discovered which have a specific affinity for these bacteria and act on these alone ... while they possess no affinity for the normal constituents of the body".

Ehrlich predicted the development of pharmaceuticals or 'magic bullets' as he called them and went on to develop chemotherapeutic treatments for sleeping sickness and syphilis. He is one of the founding fathers of pharmacy – using chemical compounds to treat disease.

Mobile radiography units are used to screen for TB, while drugs are the major way to treat TB and control its spread. TB can usually be treated with a course of four standard, or 'first-line', anti-TB drugs. If these drugs are misused or mismanaged, *multidrug resistant TB* (MDR-TB) can develop. MDR-TB is treated with 'second-line' drugs. This treatment takes longer and the drugs are more expensive and have more side-effects. If these second-line drugs are misused, *extensively drug resistant TB* (XDR-TB) strains can develop and, with treatment options limited, the mortality rate with this strain is very high.

In March 2007, the World Health Organisation (WHO) announced that the global TB epidemic had levelled off for the first time since the WHO declared TB a public health emergency in 1993. The rate at which people developed TB in 2005 was equal to or even slightly lower than that of 2004, mainly due to the implementation of the DOTS programme of treatment. However, an estimated 1.6 million people died of the disease in 2005; 195 000 of them being people who were diagnosed with HIV.

The WHO has implemented a strategy with the aim of dramatically reducing the global burden of TB by 2015 in line with the Millennium Goals. One key point of that strategy requires the development of the first new anti-TB drug in 40 years by the year 2010. The dream of Paul Ehrlich is still to be fully realised.

References:

http://www.who.int/tb/publications/2007/factsheet_2007.pdf – World Health Organisation 2007
Tuberculosis Fact Sheet

<http://www.who.int/tb/en/> – Global TB Control Report Summary 2007

<http://www.chemheritage.org/EducationalServices/pharm/chemo/readings/ehrlich.htm> – Paul Ehrlich
quote and information

‘Tuberculosis: The Greatest Story Never Told’, by Frank Ryan (Swift, 1992, ISBN 1874082006)

Case Study 2

SECONDARY DROWNING

Frank is an experienced diver and also a qualified first aid instructor. He is concerned that, following a recent sea dive, he has developed a cough, flu-like symptoms and shortness of breath. He has difficulty in obtaining an emergency appointment with his GP but finally does so.

Frank: *Thanks for seeing me doctor.*

GP: No problem, but I have to say that it does sound to me as if you have a chest infection and we have been advising people to rest and keep up their fluid intake. If it is 'flu you have, I'm sure you'll realise that antibiotics won't be any use.

Frank: *The problem is that I think it's a bit more serious than that. I'm a sub-aqua club member and dive leader. I went sea diving last weekend and I may have inhaled some sea water. I'm fairly certain that I'm suffering from secondary drowning – dry drowning some people call it. I have covered this as part of my first aid course.*

GP: Can you describe your symptoms please? You are probably more qualified to diagnose this than I am, given that the deepest water most of my patients ever see is a garden pond but we'd better eliminate other possibilities.

Frank: *Well I am certain I inhaled a small amount of sea water and although I felt OK that evening, by the following morning I had a bit of a cough and felt a bit achy. It was yesterday that I started to get concerned. I'm coughing up froth...*

GP (interrupts): What colour?

Frank: *No, it's not phlegm doctor, it's froth. I feel shivery, hot and cold and I'm really short of breath – even climbing the stairs up to your room was a real effort. I've got no energy at all and it's hard to breathe.*

GP: OK, let me listen to your chest first and then I'm going to take your blood pressure. It is beginning to sound like pulmonary oedema.

Frank: *Meaning?*

GP: Well, pretty much what you are saying – your air sacs are filling up with your own body fluids and that's the froth you are coughing up. You have a detergent-like substance in your alveoli as you probably know.
Your air sacs are not functioning properly and that explains your tiredness. You would feel the same if you had pneumonia but the cause is clearly very different. (*Doctor pauses as she takes the readings.*)

Well, I'm as certain as I can be that there is no other likely explanation.

Frank: *So are you sending me off to A and E?*

GP: Well, it may be necessary if your symptoms get worse, but I'm going to try another way first – we need to deal with the inflammation and the excess fluid so I'm giving you steroids and a diuretic – and I think we will give you an antibiotic. You are obviously well aware of what the risks are so if you notice any change, go straight to A and E.

- Frank: *Thanks Doctor – I must say I'd be happier not to have to go into hospital. I'll pick up the prescription on the way home. I can understand why you thought it was 'flu – there can't be many sub-aqua club members on your list!*
- GP: No, but I'll make sure to ask the next time anyone thinks they have 'flu!

References:

<http://www.severnsidesac.com/index.php?core=catart§ion=1&page=44&article=162> – accessed 24th May 2007

<http://www.emedicine.com/emerg/byname/submersion-injury-near-drowning.htm> – accessed 24th May 2007

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Copyright Acknowledgements:

Case Study 1 World Health Organisation 2007, *Tuberculosis Fact Sheet*, and Global TB Control Report Summary 2007 www.who.int
Sources Paul Ehrlich quote www.chemheritage.org
 Frank Ryan, *Tuberculosis: The Greatest Story Never Told*, Swift, 1992.
Case Study 2 www.severnsidesac.com
Sources www.emedicine.com

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